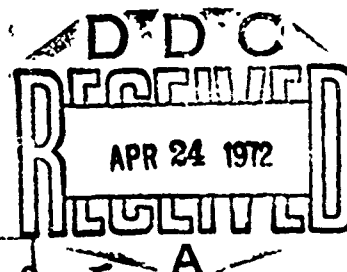
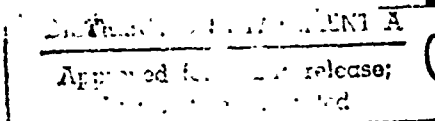


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SMALL GROUP STRUCTURE AND PERFORMANCE IN EXTREME ENVIRONMENTS

E. K. ERIC GUNDERSON

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<p>Studies of small groups of scientists and U.S. Navy personnel isolated at Antarctic scientific stations have indicated that emotional and motivational changes frequently occur during the long winter. Furthermore, some deterioration in group cooperation and accomplishment consistently appears. Prolonged confinement, space limitations, reductions of work load for some members, absence of usual outlets for emotional tensions, and social-cultural differences appear to be sources of stress. A number of personality measures have been shown to relate to adjustment in this restricted environment. Work role appears to be an important factor in determining organizational structure, social relationships, and performance effectiveness. Changes in task demands may profoundly effect the individual's own perceptions of his usefulness, his motivation, and the group's esteem for him.</p>		

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E. K. Eric Gunderson, Ph.D.

U.S. Navy Medical Neuropsychiatric Research Unit
San Diego, California

Summary

Studies of small groups of scientists and U.S. Navy personnel isolated at Antarctic scientific stations have indicated that emotional and motivational changes frequently occur during the long winter. Furthermore, some deterioration in group cooperation and accomplishment consistently appears. Prolonged confinement, space limitations, reductions of work load for some members, absence of usual outlets for emotional tensions, and social-cultural differences appear to be sources of stress. A number of personality measures have been shown to relate to adjustment in this restricted environment. Work role appears to be an important factor in determining organizational structure, social relationships, and performance effectiveness. Changes in task demands may profoundly effect the individual's own perceptions of his usefulness, his motivation, and the group's esteem for him.

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Small Group Structure and Performance in Extreme Environments¹

E. K. Eric Gunderson, Ph. D.

U.S. Navy Medical Neuropsychiatric Research Unit
San Diego, California

Plans for undersea living, space exploration, and lunar colonization have focused the attention of many behavioral scientists upon the problem of human adaptation to unusual and restricted environments. At present little empirical data are available pertaining to group interaction and effectiveness under conditions of prolonged isolation and confinement. Investigations of small groups operating under unusual or extreme conditions for long periods may reveal aspects of group structure and functioning which are not apparent under ordinary conditions.

After the International Geophysical Year (IGY) of 1957-58 -- a world-wide scientific effort in which scientists of more than 60 nations participated -- the 12 nations which had sponsored cooperative studies in Antarctica drafted a Treaty that set aside the entire continent for peaceful purposes and established freedom of scientific inquiry throughout the area. The United States has maintained several year-round stations on the Antarctic continent to implement the IGY program and, subsequently, the Antarctic Research Program sponsored by the National Science Foundation and logistically supported by the U.S. Navy.

¹ This research was supported by the Bureau of Medicine and Surgery, Navy Department, under Research Task MF 022.01.03-9001. Opinions or assertions contained herein are the private ones of the author and are not to be construed as official or as necessarily reflecting the views of the Department of the Navy.

The Antarctic station sites are in the most hostile environment inhabited by man. The Amundsen-Scott Station at the geographical South Pole is located at an elevation of more than 9,000 feet above sea-level. The mean annual temperature at the South Pole is -57°F and, during the winter months, the extremely low temperature of -110°F has been recorded. At the South Pole there is but one day and one night each year. The station is completely isolated and inaccessible from the outside world from February until November, except for intermittent radio communication.

Conditions at other United States stations are less extreme, but all groups are completely isolated and confined to close quarters for several months. Perhaps the two most critical aspects of Antarctic life at any small station are (1) that after the onset of winter there is no possibility of evacuation or of obtaining outside help, and (2) that there is no possibility of withdrawing from the group, even temporarily.

Men are selected for Antarctic assignments initially on the basis of competence in an occupational specialty. All applicants then are subjected to thorough physical and psychiatric examinations. Because each station must be a completely self-sustaining community for many months, a variety of scientific, technical, and military occupations are represented. For example, the composition of the group at the South Pole Station over several years has been approximately as follows: 13 Navy men, including a physician (Lieutenant, Medical Corps), one hospital corpsman, two radiomen, one electronics technician, two electricians, two mechanics, one carpenter, one plumber, one heavy equipment operator, and one cook; seven civilians, including three meteorologists and four physicists who conducted studies on aurora, ionosphere, geomagnetism

and cosmic rays.

The observations to be reported were obtained by means of questionnaires, rating forms, and sociometric devices from 17 small groups (ranging from 11 to 36 men) that spent approximately one year at one of four Antarctic stations: Amundsen-Scott South Pole, Byrd, Eighty, and Hallett.

Studies conducted during the two IGY expeditions revealed that many individuals found the Antarctic environment stressful. In both expeditions, symptoms pertaining to sleep disturbances, anxiety, depression, and irritability were much more common at mid-winter and at end of winter than before the winter began (Gunderson, 1963). Study of emotional changes in a more recent expedition again has indicated increases in sleep disturbances, depression, and irritability through the winter. Generally, the subjective symptoms reported by these groups resemble, in milder form, the diffuse pattern of symptoms often observed under conditions of laboratory manipulation in "sensory deprivation" experiments.

Attitude changes were studied by means of questionnaires administered on three occasions -- early winter, midwinter, and end of winter -- to nine Antarctic groups (Gunderson and Nelson, 1965). Measures of group status near the end of the long winter indicated that deterioration of group cooperation and accomplishment usually occurred, but not in all groups. These changes in group cooperation and effectiveness were shown to relate consistently to an independent criterion of group effectiveness. Maintenance of group organization, harmony, and efficiency under conditions of long-term isolation and confinement appears to be a difficult, but not an impossible task; group size and personal leadership style are known to be significant factors in group cohesiveness, and there undoubtedly are others.

Our test results have shown that not only individual emotional and motivational changes consistently occur but that some deterioration in group structure also occurs. The particular features of the station environment that are most productive of stress are not known; however, reductions in physical activity and social stimulation are inevitable in these groups. Reactions of persons to variations in external stimulation are assumed to be related to their personality structures and past histories and probably involve exaggeration of characteristic adaptive mechanisms. If this assumption is true, it is more important for prediction to know the personality characteristics and behavior patterns of the individual than to know the particular kinds of stress that he will experience. We have utilized a wide array of personality measures in our studies. I can mention but a few of these. We have found achievement needs, needs for activity, needs for social relationships and affection, aesthetic needs, needs for dominance or leadership, a sense of usefulness in one's job, and control of aggressive impulses to be particularly important for adjustment in Antarctic small groups.

Studies have been conducted of sources of stress as judged by group members. Participants have reported that inadequacy of heat or light has not been a particular problem; however, shortages of water consistently have been of concern, and personal cleanliness may become a serious concern to many after several months of isolation. Food is abundant and of good quality and represents a major source of gratification. Recreational facilities are always reported to be inadequate. Space is very limited, largely due to the enormous expense of heating living and working areas. Fire is a constant concern. Lack of privacy is a frequent complaint.

As a consequence of the prolonged confinement and restrictions in activities, many of the usual modes of dissipating emotional tensions are not available. Active sport, many common social diversions, and sexual outlets are not available. The Antarctic situation confronts group members with a number of problems that have no possibility of resolution. Men with strong needs to resolve problems (high achievement needs) might be expected to suffer more in such an environment than men with lesser needs for mastery. Our data tend to support this hypothesis for Navy personnel.

The diversity of occupational specialties in the small Antarctic group produces heterogeneity in cultural background characteristics, personal needs, values, attitudes, and personality traits. These differences in themselves can be a source of problems not easily resolved in a closed group. My colleague, Dr. Paul Nelson, has studied compatibility among three- to six-man work groups within isolated Antarctic stations (Nelson, 1964). Compatibility was shown to be related to homogeneity in age and to a lesser extent to homogeneity in rank and in social-cultural background. Compatibility of work groups also varied with homogeneity in need for prominence; work groups homogeneously low in need for prominence were most compatible.

Stability of group structure in three areas, work interaction, formal communications, and off-duty friendships, were investigated in another study (Nelson, 1964). Communication channels were consistent with formal organizational roles and were stable over time. More stability was found over the winter in work relationships than in friendship or social relationships.

The factor of most importance in the determination of group structure and interaction in this setting is work role. Not only formal organizational

structure, but informal social and friendship relationships as well are strongly influenced by job interdependence. Work role also may have an important effect upon performance effectiveness. Work loads are reduced for certain occupations, such as radio communications, during the long winter, and this change in task demands often has had profound effects upon the individual's perceptions of his usefulness, upon his job motivation and satisfaction, and occasionally upon the group's esteem for the individual. Scientists have the most stable work roles and also the most consistent feelings of positive motivation.

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